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1 Introduction

Michael Baker Corporation (Baker) has conducted extensive research into various environmental resources as a first step in development of the Tri-Service Facility Management Standards (TSFMS). This document presents the results of field research, Internet research, and literature research concerning available environmental compliance database structures. The primary focus of this effort was to identify information attributes that facilities managers need to maintain in order to effectively manage environmental compliance activities. The identified attributes have been presented in tables primarily oriented by task (e.g., storage, transportation, disposal, etc.). Secondarily, Baker has developed preliminary data models for environmental compliance based on expansion/modification of numerous components within the existing Tri-Service Spatial Data Standards (TSSDS) version 1.75. These data models represent an initial attempt at integrating the new environmental compliance tables with the TSSDS, although significant data normalization work needs to be completed in order to establish a truly functional relational database structure.

Background

The Tri-Service Center began development of the TSFMS in fiscal year 1997. It is envisioned that the TSFMS will be designed to integrate with the existing TSSDS as well as the Tri-Service A/E/C CADD standards. However, the TSFMS is to address detailed analysis, reporting, and business process considerations. The ultimate objective of the TSFMS effort is to provide minimum standards that will allow DOD installations to develop functional facilities management applications. The intent of the TSFMS is to expand on the TSSDS data model to the extent necessary to address CADD/GIS facility management requirements and to allow future interfaces with existing non-graphic databases.

Purpose and Scope

This document has been prepared to present the findings of Baker's research into available environmental management standards. The data structures presented herein are based on current compliance management activities within DOD (as determined via site visits) and on development efforts by various parties, including the United States Environmental Protection Agency [USEPA], the Department of the Navy, and the Army Reserve. In addition, Baker reviewed numerous literature sources and in-house compliance related forms/documents to identify other potential additions to the proposed TSFMS environmental data structures. Because each of the information sources used reflects standards best suited to a specific party, it was necessary to identify the most applicable standards from each source to be recommended for inclusion to the TSFMS.

This report summarizes work performed under Delivery Order No. 13 (Contract No. DACA39-96-D-005). It presents potential TSFMS database structures (including entity sets, entity classes, entity types, attributes, and

domains) for management of the following environmental issues:

a. Air Emissions/Air Quality
b. Surface Water Discharges
c. Hazardous Materials
d. Hazardous Waste
e. Regulated Storage Tanks
f. PCBs
g. Asbestos-Containing Material
h. Lead Paint
i. Indoor Air Quality

Sections 2 through 11 present results of the research and data-structure development efforts conducted to date for each of the compliance-related areas listed above. Section 12 summarizes Baker's recommendations for the presentation format of the TSFMS. As facilities management information relevant to environmental compliance is primarily non-graphic in nature, an "entity" (as defined for the TSSDS graphic tables) does not exist. Recommendations for enhancement of entities under the ***environmental_hazards*** and ***utilities*** entity sets, as applicable to the topics listed above, are discussed.

Section 13 contains a bibliography of sources used for this research project.

DESCIM Model Comparison

The original scope of work for Delivery Order No. 13 included development of a matrix comparison table between the TSSDS "**environmental_hazards**" entity set and the Defense Environmental Security Corporate Information Management (DESCIM) data models. After an initial attempt, several complications became apparent:

a. The standards set forth in the TSSDS version 1.7 are lacking in their potential for storing compliance-related information. This was found to be true of all aspects of compliance to be covered under this delivery order.

b. The DESCIM data models contain a significant capacity for storing relevant compliance related information. However, these models also contain a significant amount of information that is not spatially representable. Therefore, not all the DESCIM data tables are applicable to the TSSDS. However, such non-graphic information is relevant and applicable in development of a comprehensive Facilities Management Standard.

The dramatic differences in model structures between the TSSDS and the DESCIM did not allow for a meaningful direct comparison matrices to be developed. Consequently, the requirement to construct a direct DESCIM/TSSDS comparison matrix was deemed impractical. Baker and the Tri-Service Center agreed to abandon the matrix-comparison approach, but to continue to try to discern applicable entity types and attributes from the DESCIM for incorporation into the TSFMS.

GARIS Model Comparison

As part of this scope of work, Applied Geographics, Inc. (AGI), developers of the US Army Reserve's Geographical Army Reserve Information System (GARIS), will review Baker's data structures development efforts. Baker anticipates that AGI will perform their review of this 90% Draft document to allow their comments to be incorporated into the Final TSFMS Environmental Compliance Data Requirements Report. No GARIS related entity sets, entity classes, entity types, entities, tables, attributes, or domains have been included in this 90% Draft document.

Applicability

The applicability of this report relates to all DOD project management and technical design personnel involved in the acquisition of services from environmental GIS contractors and/or the development of TSSDS/TSFMS compliant databases. Environmental contractors who may

be involved with future development of TSSDS/TSFMS compliant databases may also benefit from the information contained herein.

Related Documents

Related, stand-alone documents that are being developed concurrently under Delivery Order No. 13 (Contract No. DACA39-96-D-005) and submitted to the Tri-Service Center include:

a. Space, Utilities, Buildings, and Real Estate Management Data Requirements Paper. Michael Baker Corporation. October 1997. 60% Draft.

b. Intergraph Facilities Management (IFM) Integrator for Windows NT Software/Tri-Service Spatial Data Standards (TSSDS), Release 1.6, Comparison Analysis Report. Michael Baker Corporation. 60% Draft. September 1997.

These documents are being developed to help the Tri-Service Center in reviewing and assembling other non-environmental facilities management standards for incorporation into the TSFMS.

Field Research Overview

Baker conducted site visits to three military installations in conjunction with Delivery Order No. 13. These included trips to one U.S. Army, one U.S. Air Force, and one U.S. Navy installation:

a. June 24 and 25, 1997
Aberdeen Proving Ground (APG), Aberdeen, Maryland (U.S. Army)

b. July 1 and 2, 1997
MacDill Air Force Base (MacDill), Tampa, Florida (U.S. Air Force)

c. July 30 and 31, 1997
Patuxent River NAS (Pax River), Lexington Park, Maryland (U.S. Navy)

The purpose of the site visits was to conduct interviews with various personnel involved with environmental compliance activities as well as other environmental issues (e.g., installation restoration). The interviews were designed to accomplish the following:

1) Determine the level of automation currently available at the bases;
2) Identify the types of information collected as part of the day-to-day facilities management activities;
3) Identify the methods by which that facilities management data is currently is managed;
4) Discuss if and how automation/ standardization of data management activities utilizing CADD/GIS could improve work practices.

The site visits provided Baker with valuable insight into the environmental management tools currently being used, and about applications for CADD/GIS technology that the facility personnel believe would be most beneficial. Two of the three installations (APG and MacDill) were not using any type of integrated, facility-wide environmental data management system. While electronic information management was being adopted by most environmental managers (usually in the form of spreadsheets or “off-the-shelf” programs), some types of records are still available only in paper format. However, at Pax River NAS, a team of business planning and information specialist has been assembled. They are in the process of developing and implementing an extensive data management system called the Activity Planning and Management Model (APMM) which includes an automated Environmental and Natural Resources Management System (ENRMS). The ENRMS module is currently running (however, some segments are still not fully developed). It contains management tools for numerous environmental compliance, natural and cultural resource management, and installation restoration (IR) project management issues. Only Pax River could provide Baker with an extensive dictionary

to evaluate for inclusion into the TSFMS for this delivery order.

Sections 2 through 10 present brief field research summaries regarding the needs and requirements for environmental compliance management tools (by compliance category). Detailed question/response documentation of the site visit interviews is provided as Appendix A (APG), Appendix B (MacDill), and Appendix C (Pax River).

2 Air Emissions/Air Quality Research

Field Research at Selected Installations

Military installations typically have numerous air emissions sources. For these sources, the facilities may be required to obtain emissions permits and perform compliance monitoring and reporting. For the major installations throughout the United States, maintaining compliance related information could be a complex and significant task. For example, it was determined from Baker's site visit to APG, that there are approximately 1,500 potential air emissions sources listed in their air emission inventory (Aberdeen and Edgewood areas). Two hundred eighty of these sources are regulated and require permits under Maryland State law. In addition, APG has also recently submitted an application to obtain a federal Title V operating permit that will require air monitoring at the facility boundary.

Emissions are generated from a variety of sources. These include boilers, paint spray booths, printing press facilities, degreasing facilities, generators, incinerators, asbestos conversion facilities, gasoline tanks and handling facilities, abrasive blasting booths, remediation systems, and unique military sources (e.g., fire safety test enclosure and fire test lab). Existing regulated sources required operating permit. New sources require pre-construction permits before construction can begin, and operating permits before their operation can begin. These permits may include emission limitations, operating restrictions, and compliance demonstrations.

Due to the potential for the generation of a large volume of air management data associated with installations, it is obviously beneficial for installations to be able to manage this information electronically. In fact, at each of the installations visited by Baker, air emissions information was available in an electronic format. However, each installation utilized different means and methods for organizing information and conducting compliance related activities (i.e., monitoring, reporting, and recordkeeping). While none of the installations were currently managing information via CADD/GIS, air compliance managers generally felt that CADD/GIS would be a useful tool for managing and extracting information relating to air emissions sources.

DESCIM Data Models

The following five DESCIM data models related to air were reviewed and evaluated:

Av1_er1.pdf	Emission Control Equipment Model
Av2_er1.pdf	Emission Control System
Av3_er1.pdf	Air Emission Process
Av4.pdf	Air Emission Acted Upon Objects
Av5_er1.pdf	*Unnamed*

The DESCIM data models were reviewed for compliance-related tables and attributes that could be incorporated into the TSFMS.

EPA's AIRS/AFS Air Pollution Management Module

EPA's Envirofacts Warehouse is stored within an Oracle database that is used to maintain information concerning numerous aspects of compliance. Baker accessed the Envirofacts Warehouse (http://www.epa.gov/enviro/html/ef_overview) to identify potential entity types and attributes that the EPA uses to manage environmental compliance information. More specifically, the Aerometric Information and Retrieval System/AIRS Facility Subsystem (AIRS/AFS) module, which maintains air pollution data on approximately 150,000 facilities regulated by the USEPA and/or state and local air regulatory agencies, was reviewed. Data models and data structures information were available within the AIRS/AFS system, as well as in a downloadable form from EPA's Environmental Data Registry (EDR) which can be accessed via http://www.epa.gov/edr. The AIRS/AFS module data-structure was evaluated for potential adaptation of components to the TSFMS. Components that could be adapted to the TSFMS database were included in the proposed data structure.

Patuxent River ENRMS Module of the APMM

Of the three installations visited, only Pax River is developing a sophisticated system that could be considered reflective of the goals of the TSFMS for managing facility resources. The Activities Planning Management Module (APMM), while still under development, contains several active modules available to base personnel for managing numerous types of facilities information. One component of the APMM is the Environmental and Natural Resources Management System (ENRMS). The ENRMS Mission Function is as follows: "The Environmental and Natural Resources Management System (ENRMS) has been developed to enable facility environmental managers to ensure base compliance, manage Installation Restoration (IR) project integrity, preserve natural and cultural resources, and execute pollution prevention programs."

The following air permitting/air quality features within ENRMS are typical of the Tri-Services entity-class level:

a. Air Sources Inventory
b. Source Usage/Emissions Estimation
c. Permit Tracking

The relevant attributes within these features were incorporated into the proposed data structure.

Other Information Sources

Baker also reviewed the following documents to identify data elements for potential inclusion into the TSFMS:

a. EPA-454/B-94-003, AIRS User's Guide, Volume AF1, Version 2.0, AFS Data Dictionary. Data dictionary of the EPA AIRS Facility Subsystem, the facility database of the Aerometric Information Retrieval System (AIRS).

b. U.S. Army, Alaska. Environmental Handbook.

c. Baker's internal air emissions/air quality compliance experience and historical documentation (through the Baker Environmental, Inc. office in Coraopolis, Pennsylvania).

3 Surface Water Discharges Research

Field Research at Selected Installations

Military installations typically have numerous surface water discharge points for which they must obtain discharge permits and perform compliance monitoring and reporting. For installations throughout the United States, maintaining compliance related information is a necessity.

Discharges can be from various sources. For example, Pax River has four industrial outfalls and over 100 storm water outfalls. In addition, Pax River has one sanitary discharge (to the local POTW). Each outfall is regulated by a permit issued under the Maryland State National Pollutant Discharge Elimination System (NPDES) program, a local program (e.g., established by the POTW), or a Pollution Prevention Plan. In addition, there may be other disposal means for wastewaters treated on-site – MacDill "recycles" wastewater via golf course irrigation and several spray fields.

Due to the potential for the generation of a large volume of compliance information, it is obviously beneficial for installations to manage this information electronically. At each of the three installations where Baker conducted interviews, at least a portion of the discharge information was available in electronic format. However, the amount and types of electronic data varied widely, and each installation had different means and methods for organizing information and conducting compliance related activities (i.e., monitoring, reporting, and record keeping). None of the installations were currently managing this information via CADD/GIS. Wastewater compliance managers were undecided on whether CADD/GIS would be a useful tool for managing and extracting information relating to surface water discharges.

EPA's PCS Surface Water Discharge Management Module

Baker accessed the Envirofacts Warehouse to identify potential entity types and attributes that the EPA uses to manage their environmental compliance information.

More specifically, the Permit Compliance System (PCS) module was reviewed. This module maintains surface water discharge information on approximately 75,000 facilities regulated by the USEPA and/or state regulatory agencies. The PCS data model structure information was available from the Envirofacts Warehouse, as well as in a downloadable form from EPA's Environmental Data Registry (EDR) which can be accessed via http://www.epa.gov/edr. The PCS module data structure was evaluated for its potential adaptation of components to the TSFMS. Because its table structure was somewhat similar to the TSSDS, the PCS was used as the primary source of attributes for the TSFMS.

DESCIM Data Models

None of the DESCIM data models provided for this research project were specific to surface water discharges. However, two models (cdmm.pdf – Compliance View and hsmo0065.pdf – *unnamed*) were screened because they contained permitting and/or other compliance related attributes that could be applicable to surface water discharge management.

Review of these models identified a number of attributes that did not have equivalents from the EPA's PCS data structure. These attributes were included in the proposed data structure.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS Module includes provisions for surface water discharge compliance data management. This model was reviewed to identify relevant fields that were not included in the PCS or DESCIM models. Fields identified by this review have been included in the recommended data model.

Other Information Sources

Baker also reviewed the following documents to identify data elements for potential inclusion into the TSFMS:

a. U.S. Army, Alaska. Environmental Handbook.

b. Pennsylvania DEP. Quarterly discharge monitoring report (DMR) form.

4 Hazardous Materials Research

Field Research at Selected Installations

Numerous hazardous materials are used to support the operations carried out at military installations. From Baker's field interviews, it became apparent that utilization of a centralized hazardous materials (HazMat) storage, tracking, and disposal system is common practice. At both MacDill and Pax River, the center responsible for these functions is known as the HazMat Pharmacy (HMP). Incoming materials are bar coded and scanned into the Environmental Management Information System (EMIS), or other similar system, and are tracked by net fluid ounce. The EMIS system transfers accountability from HMP to "customers" upon material distribution. The implementation of such tracking systems has been a recent addition to the data management systems at the bases visited, and some "bugs" are still being worked out. Despite these problems, information is updated every day and is current. The HMP's customers must submit a usage log (e-mail, fax, paper) and/or return empty containers) to demonstrate that they have used all the material before they can be issued more. This helps track hazardous materials usage "cradle to grave." Other programs link into the hazardous materials database to generate hazardous materials usage reports and provide SARA 312/313 reporting information.

It could be beneficial to link these hazardous materials databases into a CADD/GIS system to be able to graphically present the distribution of hazardous materials with the facility at any given point in time.

EPA's Envirofacts Warehouse

Baker reviewed EPA's Envirofacts Warehouse (www.epa.gov/envirofacts. warehouse) to assist in determining what fields should be included in the TSFMS database. However, a module specific to hazardous material storage and management is not being maintained. Although a Toxic Release Inventory (TRI) module is available, it only maintains information about facility releases and transfers of toxic chemicals and compounds to the environment. No attributes from the Envirofacts Warehouse were identified for incorporation into the TSFMS.

DESCIM Data Models

One DESCIM data model was reviewed and evaluated (HSMO0035.pdf) for compliance-related tables and attributes that could be incorporated into the TSFMS. Numerous attributes were identified as being potentially applicable to the TSFMS, and were included in the proposed structure.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS module database was reviewed with respect to hazardous material management. Items from this database that were applicable to the TSFMS data structure were identified and included.

Other Information Sources

Baker also reviewed the following documents to identify data elements for potential inclusion into the TSFMS. These documents include:

a. U.S. Army, Alaska. Environmental Handbook.

5 Hazardous Waste Research

Field Research at Selected Installations

Hazardous waste management is an issue of concern at nearly every military installation. These wastes are generated as the result of weapons development, weapons maintenance, and other more ”industrial” type processes that are necessary operations for bases. In addition, hazardous wastes are generated via Installation Restoration (IR) Programs, which are responsible for cleanup of contaminated sites on installations. Wastes may be RCRA and/or CERCLA regulated and non-regulated (e.g., off-spec fuels) wastes. Bases also must comply with state and local hazardous waste handling regulations, and with federal and state department of transportation requirements for shipping of these wastes (manifesting requirements). Storage locations, storage times, labeling, and submittal schedules for disposal documentation are important issues in the management of hazardous wastes. There are several potential benefits of using a CADD/GIS for management of this information. These include the generation of real-time snap shots of the types stored on site and the locations of various hazardous wastes, and the integration of this system with an automated manifesting process.

EPA’s Hazardous Waste Management Module

Baker reviewed EPA’s Envirofacts Warehouse Resource Conservation and Recovery Information System (RCRIS) module. This system maintains hazardous waste management information on approximately 700,000 facilities regulated by the USEPA and/or state regulatory agencies. The RCRIS data model structure information was available from the Envirofacts Warehouse, as well as in a downloadable form from the EPA’s Environmental Data Registry (EDR) at http://www.epa.gov/edr. The RCRIS module data-structure was evaluated for its potential adaptation of components within the TSFMS. Because its table structure was somewhat similar to the TSSDS, the RCRIS was used as the primary source of attributes for the TSFMS.

DESCIM Data Models

The following two DESCIM data models were reviewed and evaluated:

a. HSMO0015.pdf *Unnamed*
b. HSMO0055.pdf *Unnamed*

Review of these models revealed many attributes that did not have equivalents from the EPA’s RCRIS data structure. This is due essentially to the fact that the EPA’s model is intended for use for track facility permit or closure status, compliance with Federal and State

regulations, and cleanup activities. These attributes are included in the proposed data structure.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS module was reviewed with respect to hazardous waste management. Items identified as potentially applicable were included in the proposed TSFMS.

Other Information Sources

Baker also reviewed the following documents to identify data elements for potential inclusion into the TSFMS. These documents include the following:

a. U.S. Army, Alaska. Environmental Handbook.

6 Regulated Storage Tanks Research

Field Research at Selected Installations

The military uses above-ground storage tanks (ASTs) and underground storage tanks (USTs) for numerous base-related functions (e.g., jet fuel storage). These tanks are required to comply with the state regulations that govern ASTs and USTs. At many installations, the use of USTs is being eliminated (whenever possible), as inspection, monitoring, and reporting requirements are higher cost items for USTs. Bases are typically using "off-the-shelf" database programs (e.g., TankMan or Tanks2) to manage their AST and UST related information.

Application in CADD/GIS could be useful for locating associated piping and nearby utilities, scheduling and reviewing inspections records, issuing confined space entry permits, and accessing design/materials storage information. Sharing of various tank related information between departments (e.g., engineering, public works, environmental) would become more efficient through a centrally maintained CADD/GIS system.

DESCIM Data Models

Two DESCIM data models were reviewed and evaluated - TANKALL2.pdf, Tankman Data Model, and TK7PRPKG.pdf, Tankman Data Model and Proposed Package Data Model. The DESCIM data models were reviewed for spatially oriented compliance-related tables and attributes of topics related to the management of storage tanks and their associated piping. These models were checked for tables and attributes that could be used to supplement the existing TSSDS structure.

AST and UST Inspection Checklists

Baker has performed numerous inspections of ASTs and USTs for a variety of public and private sector clients. For these projects, Baker developed inspection checklists to address the issues related to management of tanks and their associated piping. The content of these checklists was reviewed and compared to the existing TSSDS database to identify data fields that could be included in the TSFMS standards. All potentially applicable fields were added to the list of recommended attributes for the TSFMS standard.

Patuxent River ENRMS Module of APMM

Pax River's ENRMS models includes storage tank management features. The data dictionary was reviewed for information that could be added to the TSFMS. All potentially applicable fields were added to the list of recommended attributes for the TSFMS standard.

7 PCBs Research

Field Research at Selected Installations

Polychlorinated Biphenyl (PCB) wastes are regulated under the federal Toxic Substances Control Act (TSCA). During Baker's site visits, it was found that the bases had completed or were very near completing all of their PCB removal actions. The PCB documentation that remains is primarily historical records either in paper form (e.g., manifests and certificates of disposal) and/or electronic form (typically spreadsheets developed by project managers). It was generally believed that these records could continue to be maintained in their present format and that at this late date it would be difficult to justify the cost of placing them into a centralized database structure.

At the bases visited, CADD/GIS was not envisioned as an effective tool for management of PCB wastes. One person recommended that efforts be concentrated more on management of recycled wastes such as oils, paper, metals, and glass.

Although the facilities visited by Baker have little or no use for a PCB management data structure as part of the TSFMS, other military installations may benefit from development of such a system. In addition, relevant historical records potentially could be managed through this system. Therefore, the development of facility management data standards for PCBs is warranted.

DESCIM Data Models

One DESCIM data model showed attributes relevant to PCBs management:

TOXICV2.pdf Toxic Substance View

This model was reviewed for spatially oriented compliance-related tables and attributes that could be incorporated into the TSFMS. Where such attributes were identified, they were added to the proposed TSFMS data structure.

EPA's EnviroFacts Warehouse

EPA's EnviroFacts Warehouse is an Oracle database that maintains information concerning numerous aspects of compliance. Baker reviewed the EnviroFacts Warehouse to identify potential entity types and attributes that the EPA uses to manage environmental compliance information. The data model and data structure information was available in downloadable form from EPA's Environmental Data Registry (EDR) (http://www.epa.gov/edr). The data structure was evaluated for potential adaptation of components to the TSFMS. When relevant when relevant entities and attributes were identified, they were included in the proposed data structure for the TSFMS.

Patuxent River ENRMS Module of the APMM

Within PAX River's ENRMS module of the APMM, there is no provision for PCB's management. Thus, ENRMS was not used as a source of tables/attributes when developing the PCBs compliance data structure for the TSFMS.

Other Information Sources

Baker also reviewed the following documents to identify data elements for potential inclusion into the TSFMS:

a. U.S. Army, Alaska. Environmental Handbook.

b. USEPA. Toxic Substances Control Act (TSCA).

Baker's internal personnel experienced in PCB-related projects were used to help identifying other potential attributes.

8 Asbestos Containing Material (ACM) Research

Field Research at Selected Installations

The majority of military installations typically have extensive asbestos problems for which they must manage the removal and disposal of the materials over time. Most have undergone an asbestos survey in the past, and have asbestos-containing materials (ACM) on base. Several bases report that there may be over 20,000 different ACMs that will ultimately require treatment/disposal. The timing of remediation is dictated by building renovation or demolition. At that time, ACMs must be effectively dealt with. For installations throughout the world, management of the removal actions and maintenance of compliance related information is a necessity. There is a definite and urgent need for an effective way to manage the locations of ACMs, to record the form(s) in which they are present, and to be able to schedule/manage removal actions. Databases compiled with CADD/GIS would be an extremely effective tool for management of ACM hazards.

DESCIM Data Models

One DESCIM model - TOXICV2.pdf - Toxic Substance View – contained information related to the management and abatement of ACMs. This model was reviewed and evaluated for spatially oriented compliance-related tables and attributes associated with the evaluation, control and remediation of ACM. These tables and attributes then were checked for fields that could be integrated into the TSFMS data standards. When relevant fields were identified, they were added to the proposed data structure.

pcV3© Software – Asbestos, Lead-Based Paint & Facility Management Software

pcV3© Software is an interactive database that allows facility management personnel to maintain large amounts of data related to asbestos and lead-based paint. Survey data (detailed and representative), lab results, quantities, conditions, photographs, building plans and abatement activities can all be entered in and reviewed through pcV3©. It combines both text and graphical data in providing a comprehensive record-keeping and management tool. The DESCIM Program Office has selected this program for tracking their asbestos and lead paint abatement activities.

The pcV3© ACM tracking model was reviewed for tables and attributes related to the evaluation, control and remediation of asbestos-containing materials. These tables and attributes then were checked for fields that could be integrated into the TSFMS data standards. When relevant fields were identified, they were added to the proposed data structure.

Baker's DoDDS Activities ACM Database

Baker has performed a significant quantity of work related to the evaluation, control and remediation of ACMs for the Department of Defense under the Department of Defense Dependents Schools (DoDDS) Program. As part of this project, Baker has developed a database for storing information related to the ACM investigation and remediation. The content of this database was reviewed and compared to the existing TSSDS database to identify data fields that could be included in the TSFMS data standards. When relevant fields were identified, they were added to the proposed data structure.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS module includes ACM management features. The data dictionary was reviewed for information that could be added to the TSFMS data standards. When relevant fields were identified, they were added to the proposed data structure.

Other Information Sources

Baker also reviewed information available on the Environmental Protection Agency's (EPA's) home page (http://www.epa.gov) to identify additional areas of concern that should be included in the TSFMS data standard. When relevant issues were identified, they were added to the proposed data structure.

9 Lead-Based Paint Research

Field Research at Selected Installations

Military installations typically have extensive lead paint problems. The lead paint must be removed and disposed of properly. All of the installations visited have undergone at least one lead paint survey in the past, and have been found to have lead paint problems. Lead Paint remediation is dictated primarily by risk, with family housing receiving the highest priority (although abandoned family housing units are not considered high risk). Office buildings are considered "medium-risk" structures and may or may not be scheduled for remediation. Other structures such as hangars and maintenance buildings are assigned a low priority and are not included in the remediation schedule. For installations throughout the world, management of lead paint removal actions and maintenance of compliance related information is a necessity. There is a definite and urgent need for an effective way to manage the data related to lead paint and its abatement, including the locations of lead paint areas and the managing and scheduling of removal actions. Databases coupled with CADD/GIS would be an extremely effective tool for management of lead paint contamination.

DESCIM Data Models

One DESCIM model - TOXICV2.pdf - Toxic Substance View – included information potentially related to lead paint assessment and removal. This model was reviewed and evaluated to identify compliance-related tables and attributes related to the evaluation, control and remediation of lead-based paint. These tables and attributes then were checked for fields that could be integrated into the TSFMS data standards. When related fields were identified, they were included in the proposed data structure.

pcV3© Software – Asbestos, Lead-Based Paint & Facility Management Software

As noted in Section 8.0, pcV3© Software is an interactive database that allows facility management personnel to maintain large amounts of data related to asbestos and lead-based paint.

The lead-based paint tracking module was reviewed and evaluated. Attributes found to be relevant to the TSFMS have been included in the proposed data standards.

Baker’s DoDDS Activities ACM Database

Baker's ACM investigation and remediation database was reviewed to identify data attributes that also could be applied to work with the evaluation, control and remediation of lead-based paint. These fields have been included in the TSFMS data standards.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS module includes lead paint management features. This database was reviewed for information that could be added to the TSFMS data standards. Relevant fields have been included in the proposed TSFMS data standards.

Other Information Sources

Baker also reviewed information available on the EPA’s home page (http://www.epa.gov) to identify additional areas of concern that should be included in the database.

10 Indoor Air Quality (IAQ) Research

Field Research at Selected Installations

During the site visits, Baker found very little information on the management of indoor air quality (IAQ) issues such as radon gas monitoring, sick-building syndrome, and the presence of other hazardous air pollutants (e.g., formaldehyde). Situations that may affect the health and well being of base personnel typically do exist, or have existed in the past. Generally, these are dealt with on a case-by-case basis and there is no centralized management of the information collected. Typically, IAQ issues are identified based on complaints from base personnel. They may also be identified by OSHA monitoring. When an IAQ issue does develop, it is investigated immediately and dealt with as deemed appropriate by base health and safety experts. Although it may be useful to manage IAQ issues through a centralized database/GIS framework, there is not a sense of urgency to develop such a management tool.

DESCIM Data Models

The DESCIM data model does not include any information related to the management, control and clean up of indoor air hazards.

Patuxent River ENRMS Module of the APMM

Pax River's ENRMS module does not include any information related to the management, control and clean up of indoor air hazards.

Other Information Sources

Baker also reviewed information available on the EPA's IAQ web page (http://www.epa.gov) to identify areas of concern that should be included in the database. This page included results of IAQ studies completed by the EPA. In addition, the California Environmental Protection Agency's Air Resources Board IAQ web page (http://arbis.arb.ca.gov/indoor) was reviewed for information related to IAQ issues and concerns. The relevant items were then integrated into the TSFMS data standards.

11 Data Modeling and TSFMS Format Recommendations

TSFMS Objectives

Baker believes that the two most critical factors that the Tri-Service Center must consider in developing the TSFMS are the following:

1) How will facility managers access environmental information as technology progresses?

2) How can the database structures be standardized so that information can be transferred between military installations?

During Baker's site interviews, it was found that environmental managers are primarily using spreadsheets and/or self-contained (often proprietary) databases to manage their electronic information. While this generally provides for adequate electronic record keeping, it does not permit information sharing between people on base nor between environmental managers conducting similar activities at other installations. Most facility managers like the concept of accessing facility management information through a GIS system; however, they believe that a GIS should be a secondary means of data retrieval/presentation. There was a greater comfort level with accessing and inputting information through more traditional database applications. Therefore, the Tri-Service Center needs to provide the necessary links between the spatial components of the TSSDS and the non-graphical TSFMS facility management data tables. However, the non-graphic tables must still be accessible through other database accessing means/applications.

As technology progress and the DOD streamlines their operations, it will be necessary to maintain facilities management data through a centralized database system. Databases allow numerous advantages over the independent systems that many installations are currently implementing. First, sharing of information between facility managers and installations becomes possible. Also, standardized databases are capable of being accessed either through multiple desktop applications (such as the ENRMS module of the APMM) or through spatial GIS software. (Interfacing may be necessary for some applications.) In addition, statistical analyses and costing analyses can be implemented to help make better business decisions at lower cost. In this report, Baker makes recommendations for TSFMS formatting to accomplish this goal.

Non-Graphic Information (TSFMS)

Baker's review of the TSSDS structure revealed that numerous tables of a non-graphical nature already exist which are necessary for general facilities management information which can be linked to ***enviromental_compli-ance*** specific tables. Numerous tables under the ***common*** and ***environmental_hazards*** entity sets were found to be non-graphic and deemed to have greater applicability to a facilities management

through a database (typical non-graphic user interface) interface than through a GIS interface.

As shown on Table 1, Baker recommended that most of the non-graphic tables under these two entity sets be moved to the TSFMS, yet remain linked to the graphic components of the TSSDS as necessary. This will allow for greater ease of managing data that is not easily represented spatially, but which is required for the thorough management of all facilities.

Not all of the non-graphic tables should be migrated to the TSFMS. Similar tables should be constructed (e.g., cmgenmet) or should have a parallel table in the TSFMS. Other non-graphic tables which describe geospatial entities should remain within the TSSDS.

Graphic Information (TSSDS)

It is recommended that all information designated as being graphical in nature (entity identification number, name, coordinates, etc.) remain in the existing TSSDS spatially related tables. Some of the entities will require either representation via a new/modified symbol or to add discriminators to differentiate based on environmental compliance status or category. It is recommended that records in each graphic table be modified to contain the appropriate foreign keys to allow the data to be linked to the non-graphic TSFMS data. Although it is not envisioned that a GIS will be the primary access to that information by facility managers, the capability should be included as each manager has different needs and preferences.

Environmental Projects

Almost every environmental project incorporates compliance issues that must be addressed. Depending on the task-on-hand, the regulations with which the activity must comply may be enforced by different agencies at the federal, state or local level, or a combination thereof. Baker initially considered dividing the non-graphic TSFMS compliance information relating to the nine environmental topics (see Section 1) into the following four (4) entity sets, roughly corresponding with the type of agency responsible for enforcing the action:

1. environmental_compliance
2. osha_compliance
3. transportation_compliance
4. voluntary_compliance

However, as the TSSDS was established based primarily on project type, it was decided that only one new entity set, ***environmental_compliance***, be established with references to the appropriate type of compliance established only in the "Common Name" field associated with each table. This helps to minimize confusion on where to find the appropriate tables when browsing the TSFMS data structure through an application such as the TSSDS.

Air Emission/Air Quality

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) related facilities management were identified:

Air Pollutant
Air Emissions Activity Profile
Air Emissions Permits
Air Emissions Permit Applications
Emissions Monitoring
Emissions Reporting - Quality
Emissions Control Maintenance
Training
Emissions Compliance Audits
Emissions Inspections

The proposed data structure for air emission/air quality compliance is presented in Appendix G, Tables G1 through G5. The preliminary data model for air emissions/air quality compliance is provided as Figure 1. The data

model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A table has been developed for each of the ten categories listed. Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains no "non-graphic" tables specifically related to air emissions or air quality for incorporation into the TSFMS. Therefore, Baker recommends only adding the appropriate keys to the TSSDS tables to be able to access the non-graphical information of the TSFMS from a CADD/GIS application.

In addition, no additional entity types for incorporation into the TSSDS were revealed during Baker's research. However, based on a review of TSSDS v. 1.7, and on discussions with air quality personnel, the Tri-Service Center should modify the symbol for an air quality monitoring station. This modification should be based on whether it is an internal (on-site), facility boundary, or external (off-site) monitoring station. This can be done simply by assigning a discriminator to vary the color of symbol #101 (ECAQMS) or by addition of a subscript (e.g., A_i, A_{fb}, or A_e) to the graphic feature.

In addition, no symbol is currently present under the entity type ***air_emissions_source_site*** (a point/polygon object). Baker recommends that a standard symbol for a point source be adopted and assigned discriminators such that it can be modified (by color) to indicate whether or not the source is permitted.

Surface Water Discharges

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to surface waste discharges:

Surface Water Discharge Pollutant
Surface Water Discharge Activity Profile
Surface Water Discharge Permits
Surface Water Discharge Permit Applications
Discharge Monitoring
Reporting - Quality
Discharge Systems/Equipment Maintenance
Operator Training
Discharge Compliance Audits
Outfall Inspections

The proposed data structure for surface water compliance is presented in Appendix G, Tables G1 through G5. The preliminary data model for surface water discharge compliance is provided as Figure 2. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains no “non-graphic” tables for incorporation into the TSFMS. Therefore, Baker recommends only adding the appropriate keys to the TSSDS tables

to allow access to the non-graphical information of the TSFMS from a CADD/GIS application.

One additional entity type was identified for incorporation into the surface water section of the TSSDS during Baker's research. It is recommended that a new entity type be introduced called ***surface_water_ disc_monitoring_station_point***. The entity itself exists, but appears to be misplaced under the ***groundwater_quality_monitoring_ station_point*** entity class. There also appears to be some confusion as similar entities exists under the ***utilites*** entity set: ***industrial_waste_discharge_point***, ***storm_sewer_discharge_point, wastewater_discharge_point***. Typically, storm sewers are considered part of utilities, while wastewater treatment facilities (industrial and sanitary) and their associated outfalls are considered part of an environmental treatment operations. The Tri-Service Center may want to consider shifting industrial waste and wastewater under the ***environmental_hazards*** entity set and providing additional clarification as to the definition of each entity.

Based on review of TSSDS v. 1.7 and discussions with wastewater/storm water professionals, the symbol for the ***surface_ water_disc_monitoring_station_point*** (symbol #114, ECSWMS) should indicate whether the source of the discharge is wastewater, storm water, or mixed. Baker recommends the addition of a subscript (e.g., SW_{ww}, SW_{st}, and SW_{mx}) to the graphic feature to make this indication. These symbols also need to be varied to indicate the station's compliance related location as an internal, an end-of pipe, or an edge of mixing zone outfall. This can be done simply by varying the color codes used for each entity through discriminators.

In addition, the field sample collection location point entity needs to include separate symbols for surface water (not directly related to discharges), wastewater, storm water, and mixed wastewater/storm water sample locations. Baker recommends the addition of a subscript (e.g., W_s, W_{ww}, W_{st}, and W_{mx}) to the graphic feature to make this indication.

Hazardous Materials

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to hazardous materials compliance/management:

Hazardous Materials Inventory
Hazardous Materials Storage
Hazardous Materials Safety Data
Hazardous Materials Training
Hazardous Materials Issuance

The proposed data structure regarding hazardous materials compliance is presented in Appendix G, Tables G1 through G5. The preliminary data model for hazardous materials compliance is provided as Figure 3. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains several “non-graphic” tables associated with hazardous materials:

ehhwmcma
ehhwmcpp
ehhwmmem
ehhwmmiw
ehhwmrwa

Baker recommends moving these tables to the TSFMS. The appropriate keys to the TSSDS tables to allow access to the non-graphical information of the TSFMS from a CADD/GIS application, should already exist. New keys will need to be added to link the graphic and non-graphic TSSDS tables to the proposed new environmental compliance tables, as appropriate.

No additional entities were identified for incorporation into the TSSDS. The five existing entity types (tables) should be sufficient to represent hazardous materials adequately from a graphics standpoint:

ehhmwhml	(location - non-graphic parent table)
ehhmwhma	(storage area)
ehhmwhmb	(storage building)
ehhmwhmr	(storage room)
ehhmwhmv	(storage vault)

Hazardous Wastes

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to hazardous waste compliance/management:

Hazardous Waste Inventory
Hazardous Waste Activity Profile
Hazardous Waste Permits
Hazardous Waste Risk Assessment
Hazardous Action Plans
Hazardous Waste Training
Hazardous Waste Exposure - Worker
Hazardous Waste Exposure - Remediator
Hazardous Waste Storage
Hazardous Waste Transportation
Hazardous Waste Treatment/Disposal

The proposed data structure regarding hazardous materials compliance is presented in Appendix G, Tables G1 through G5. The preliminary data model for hazardous waste compliance is provided as Figure 4. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains several “non-graphic” tables associated with hazardous wastes:

ehhwmcpw
ehhwmcwa
ehhwmmew
ehhwmmiw
ehhwmrwa

Baker recommends moving these tables to the TSFMS. The appropriate keys to the TSSDS tables, to allow access to the non-graphical information of the TSFMS from a CADD/GIS application, should already exist. New keys will need to be added to link the graphic and non-graphic TSSDS tables to the proposed new environmental compliance tables, as appropriate.

No additional entities were identified for incorporation into the TSSDS. The five existing entity types should be sufficient to represent hazardous waste adequately from a graphics standpoint:

ehhmwhsl	(location - non-graphic parent table)
ehhmwhsa	(storage area)
ehhmwhsb	(storage building)
ehhmwhsr	(storage room)
ehhmwhsv	(storage vault)

Regulated Storage Tanks

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to AST and UST compliance/management:

Tank Inventory
Tank Contents and Conditions
Tank Permits
Tank Spill Management
Tank Training
Tank Entries
Tank Inspections

The proposed data structure for regulated storage tanks compliance is presented in Appendix G, Tables G1 through G5. The preliminary data model for regulated storage tank compliance is provided as Figure 5. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains one “non-graphic” table associated with tanks:

ehtnktnk

Baker recommends that this table be kept with the TSSDS because it is a parent table to other graphic AST (ehtnkast), UST (ehtnkust) and tank farm (ehtnkfrm) related tables. These four existing entity types should be sufficient to represent tank management. However, Baker recommends using discriminators to indicate whether an AST or UST is permitted (regulated), unpermitted, or abandoned. During the site interviews, facility managers indicated that nearly all tanks were managed, whether they are regulated or not.

PCBs Management

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to regulated storage tank compliance/management:

PCB Inventory
PCB Surveys
PCB Risk
PCB Action Plans
PCB Exposure - Worker
PCB Exposure - Remediator
PCB Storage
PCB Transportation
PCB Treatment/Disposal

The proposed data structure for PCBs compliance is presented in Appendix E, Tables G1 through G5. The preliminary data model for PCBs compliance is provided as Figure 6. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains no “non-graphic” tables associated with PCBs. The single

existing entity types (ehhwmpcb) should be sufficient to represent PCBs management. However, Baker recommends using discriminators to indicate whether a contained PCB source remains to be or has been remediated. During the site interviews, facility managers indicated that most sources had already been remediated, but it was very important to maintain historical records of sources that have been remediated in the event of an audit. These should be available through a GIS interface.

ACM Management

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to ACM compliance/management:

ACM Inventory
ACM Surveys
ACM Risk
ACM Action Plans
ACM Exposure - Worker
ACM Exposure - Remediator
ACM Storage
ACM Transportation
ACM Treatment/Disposal

The proposed data structure for ACM compliance is presented in Appendix E, Tables G1 through G5. The preliminary data model for ACM compliance is provided as Figure 7. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains one “non-graphic” tables associated with ACM (ehbdhacm). In addition, a common graphical table is used to define ACM, lead-paint, and indoor air hazards. Baker recommends moving the non-graphic table to the TSFMS. The appropriate keys to the TSSDS tables, to allow access to the non-graphical information of the TSFMS from a CADD/GIS application, already exist. New keys will need to be added to link the graphic TSSDS tables to the proposed new environmental compliance tables, as appropriate.

The single existing entity types (ehbdhbdh) should be sufficient to represent ACM. The symbology must remain generic, because ACM problems are three-dimensional (not two-dimensional), making it impossible to represent every individual source spatially. However, facility managers must manage and track the activities associated with each source, thus necessitating non-graphical ACM management tables. Baker recommends using discriminators to indicate whether a building hazard is attributed to ACM, lead-based, paint, or an indoor air quality problem.

Lead-Paint Management

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to lead-based paint compliance/management:

Lead-Paint Inventory
Lead-Paint Surveys
Lead-Paint Risk
Lead-Paint Action Plans
Lead-Paint Exposure - Worker

Lead-Paint Exposure - Remediator
Lead-Paint Storage
Lead-Paint Transportation
Lead-Paint Treatment/Disposal

The proposed data structure for lead-paint compliance is presented in Appendix E, Tables G1 through G5. The preliminary data model for hazardous waste compliance is provided as Figure 8. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic).

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains one "non-graphic" table associated with
lead-based paint (ehbdhlph). In addition, a common graphical table is used to define ACM, lead-paint, and indoor air hazards. Baker recommends moving the non-graphic table to the TSFMS; the appropriate keys to the TSSDS tables to allow access to the non-graphical information of the TSFMS from a CADD/GIS application already exist. New keys will need to be added to link the graphic TSSDS tables to the proposed new environmental compliance tables, as appropriate.

The single existing entity types (ehbdhbdh) should be sufficient to represent lead-paint. The symbology must remain generic, because lead-paint problems are three-dimensional (not two-dimensional), making it impossible to represent every individual source spatially. However, facility managers must manage and track the activities associated with each source, thus necessitating non-graphical lead-paint management tables. Baker recommends using discriminators to indicate whether a building hazard is attributed to ACM, lead-based, paint, or an indoor air quality problem.

Indoor Air Quality Management

Proposed TSFMS Data Model Structure

The following non-graphical information groups (entity classes) were identified as being necessary for the management of data related to indoor air hazards compliance/management:

Indoor Air Complaints Log
Indoor Air Standards (Voluntary)
Indoor Air Monitoring
Indoor Air Corrective Actions

The proposed data structure for indoor air quality management is presented in Appendix G, Tables G1 through G5. The preliminary data model for hazardous waste compliance is provided as Figure 8. The data model is presented as a preliminary indication of how the TSFMS tables might link to the existing TSSDS tables (graphic and non-graphic). Indoor air quality is unique in that it is the only topic where compliance is completely voluntary. Although standards exist for various industries, they are not enforceable by any government agency.

A separate attribute table has been developed for each of these entity classes.
Baker has given each new table Tri-Service compliant nomenclature. In addition, attribute names have been made Tri-Service compliant. Sources for the attributes as identified through Baker's research and development effort are listed on Table G5.

Modifications to the TSSDS

The existing TSSDS contains one “non-graphic” table associated with Indoor air hazards (ehbdhiah). In addition, a common graphical table is used to define ACM, lead-paint, and indoor air hazards. Baker recommends moving the non-graphic table to the TSFMS. The appropriate keys to the TSSDS tables, to allow access to the non-graphical information of the TSFMS from a CADD/GIS application, already exist. New keys will need to be added to link the graphic TSSDS tables to the proposed new environmental compliance tables, as appropriate.

The single existing entity types (ehbdhbdh) should be sufficient to represent indoor air hazards. Baker recommends using discriminators to indicate whether a building hazard is attributed to ACM, lead-based, paint, or an indoor air quality problem. The symbology must remain generic because indoor air quality problems may be from a combination of sources or unknown sources, or may be widespread, making it difficult to represent two-dimensionally.

Model Consolidation for Final Report

For each of the topics discussed above, Baker has created a new table for each category and each task. For the final document, we expect to be able to consolidate some of these tables under a ***common_general*** entity class within the TSFMS. For example, there is no reason why training issues cannot be consolidated into a single table accessible and queryable through a single table (rather than one for hazardous materials, one for hazardous waste, one for tanks, etc.). Other entity types may also be consolidated, such as:

Action Plans (Baker may just enhance the existing cmgenpln)
Risks
Exposure - Worker and Remediator

Other items such as inventories and waste tracking from cradle-to-grave (storage, transportation, treatment/disposal) should remain independent based on waste type. Additional work needs to be done to pare down the overall data structure, normalizing the data, and developing data relationships between the graphic and non-graphic tables. These items will require an extensive effort, but are highly recommended to enable the database to be more functional. Such an effort would likely result in modifications, additions, and deletions to the proposed data structures presented herein.

Browser Recommendations

Baker has reviewed the new Browser features available in the TSSDS v. 1.75 and finds the new capabilities and ease of standards browsing to be a great enhancement to the application. It is Baker's belief that the TSSDS and TSFMS could be (and need to be as join relations must eventually be established) relatively easily merged into a common application. The TSSDS already contains a lot of common tables that are TSFMS oriented. Baker recommends having the capability to browse the non-graphical TSFMS tables separately from the graphical TSSDS tables (primarily). Establishing a separate set of buttons for the TSFMS which recognize only database records tables which include "TSFMS" (or "FMS" in v. 1.7) in the "STANDARDS" field would allow selective browsing. Likewise, programming to get the existing TSSDS buttons to recognize "TSSDS" (or "SDS" in v. 1.7) in the "STANDARDS" field would allow only the graphic tables to be viewed. With minor modifications, the TSSDS package could be expanded to include both the TSSDS and the TSFMS in a single browser package.

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